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INSTALLATION RESTORATION  
AT  
ROCKY MOUNTAIN ARSENAL

DECONTAMINATION ASSESSMENT  
FOR LAND AND FACILITIES AT RMA

EXECUTIVE SUMMARY

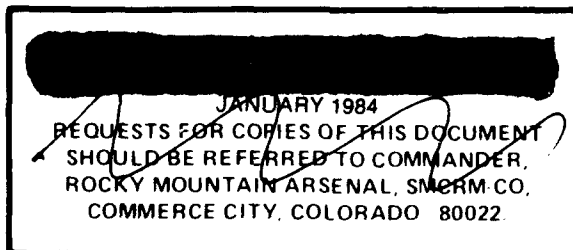
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ROCKY MOUNTAIN ARSENAL  
CONTAMINATION CONTROL PROGRAM  
MANAGEMENT TEAM

JANUARY 1984

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PREPARED FOR




US ARMY  
TOXIC AND HAZARDOUS MATERIALS AGENCY  
AND ROCKY MOUNTAIN ARSENAL



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13. ABSTRACT (Maximum 200 words) THIS REPORT PROVIDES AN ASSESSMENT OF TECHNICAL APPROACHES AND COSTS ASSOCIATED WITH DECONTAMINATION OF ALL OR PORTION OF ROCKY MOUNTAIN ARSENAL (RMA) LANDS AND FACILITIES NEAR DENVER, COLORADO. THE REPORT DISCUSSES ENVIRONMENTAL LAWS AFFECTING DECONTAMINATION ACTIVITIES AND VOLUMES, TYPES AND AREAS OF CONTAMINATION BY HAZARDOUS OR POTENTIALLY HAZARDOUS MATERIALS. APPROXIMATELY NINETY SITES ARE DISCUSSED WHICH ARE BELIEVED TO CONTAIN ABOUT 16 MILLION CUBIC YARDS OF CONTAMINATED OR POTENTIALLY CONTAMINATED MATERIAL. THE REPORT EVALUATES TECHNICAL APPROACHES FOR ATTAINING DECONTAMINATION AND PRESENT COST ESTIMATES FOR FOUR CLEANUP SCENARIOS. SINCE RMA IS CURRENTLY INVOLVED IN A NUMBER OF ON-GOING MILITARY MISSIONS, THE DEPARTMENT OF THE ARMY HAS NO PRESENT PROGRAM TO DECONTAMINATE RMA FOR ALTERNATIVE LAND USES. THEREFORE, THE REPORT IS PREPARED FOR ARMY PLANNING PURPOSES ONLY AND IS NOT INTENDED TO INDICATE ANY DECISIONS REGARDING DISPOSITION OF RMA PROPERTY. ADDITIONAL INVESTIGATION WOULD BE REQUIRED TO FINALIZE THESE COST ESTIMATES IF THE DEPT. OF DEFENSE DECIDES ON					
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**US ARMY  
TOXIC AND HAZARDOUS MATERIALS AGENCY  
AND ROCKY MOUNTAIN ARSENAL**



## EXECUTIVE SUMMARY

The purpose of this report is to document the results of a multi-year study to assess the feasibility and cost of decontaminating all or portions of Rocky Mountain Arsenal (RMA) in Colorado. Since RMA is currently involved in a number of on-going military missions, the Department of the Army (DA) has no present program to decontaminate RMA for alternative land uses. Therefore, the report is prepared for DA planning purposes only and is not intended to indicate any decision regarding disposition of RMA property. It is noted, however, that the City of Denver has requested that the Federal Aviation Administration implement procedures to transfer approximately four square miles along the RMA's southern boundary for expansion of Stapleton International Airport. While the request is under study, the Army has not decided whether such a transfer would or would not be appropriate.

Rocky Mountain Arsenal occupies approximately 17,000 acres in Adams County, Colorado adjacent to Denver's Stapleton International Airport (Figure 1). The property has been occupied by the RMA since 1942. During this time it has been used for the manufacture of chemical warfare items, demilitarization of chemical agent filled shells and destruction of obsolete ordnance. Certain portions of RMA have also been leased for the manufacture of pesticides and herbicides.

There are numerous sites at RMA where there are hazardous wastes. Contaminants from these sites have occasionally migrated off the installation.

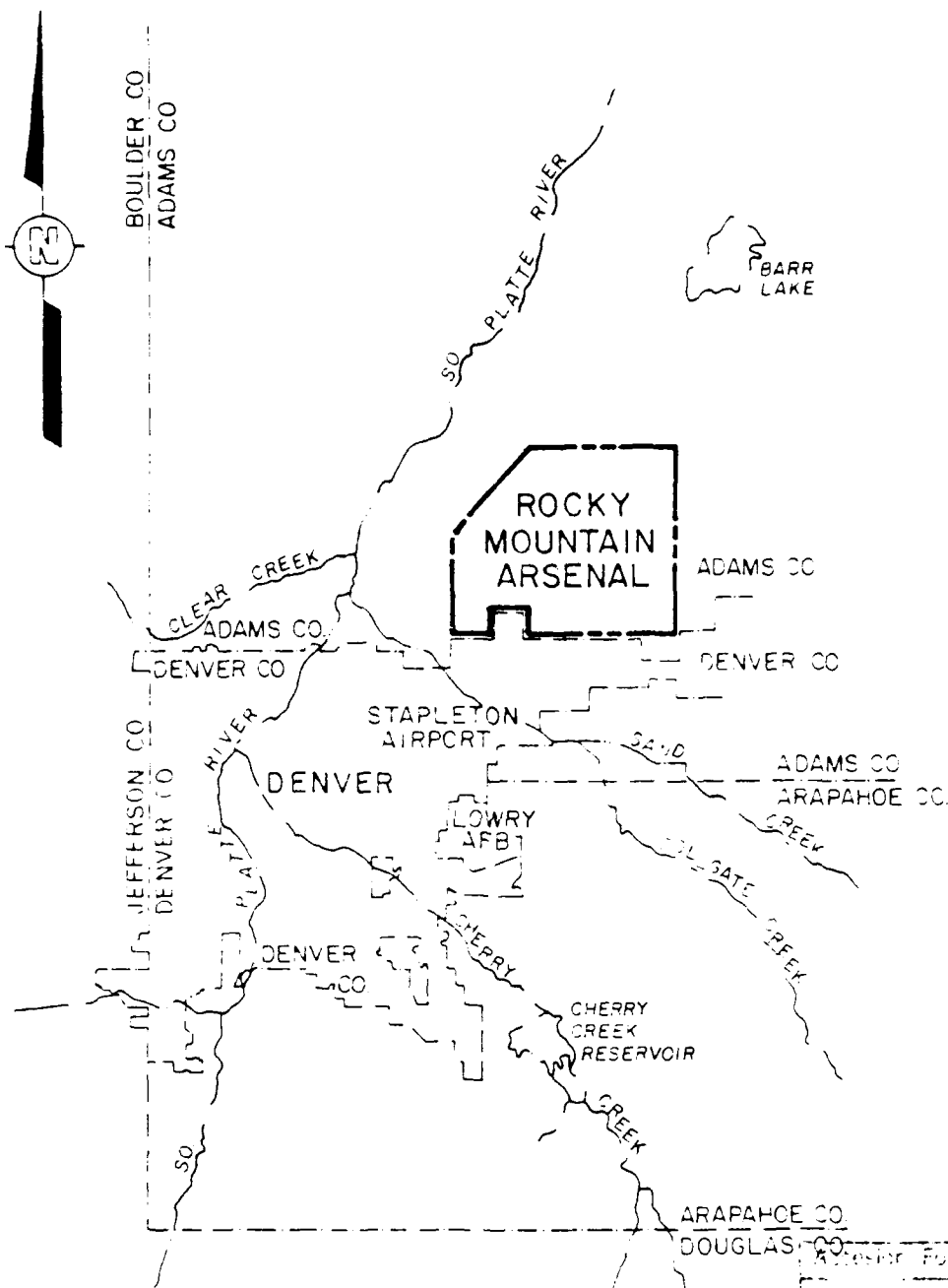


FIGURE 1  
LOCATION MAP

Approved For	
NAME GRADE	DATE
BY	DATE
Distribution	
Availability Codes	
CLASS	GROUP
A-1	

The approach used for this decontamination assessment involved 1) review of applicable Federal and State requirements affecting decontamination of Government real property, 2) review of existing data to define areas, types and volumes of contamination at RMA, 3) development of technical approaches to decontaminate RMA property and 4) estimation of costs for both partial and total unrestricted use of RMA. Decontamination procedures employed were constrained to:

- o Ensure that RMA is in compliance with applicable State and Federal environmental statutes.
- o Be capable of being accomplished in a reasonable time frame using existing technology.
- o Not address release of RMA lands or facilities nor speculate as to future alternative land uses.
- o Consider known and suspect contamination sites resulting from operations on RMA by both the Army and its tenants.

Department of Defense (DOD) policies dealing with toxic and hazardous material cleanup, unexploded ordnance neutralization and chemical agent demilitarization are described in Chapter 2. The chapter addresses decontamination levels and extent, which are the two key issues that guide development of the later decontamination cost estimates. The intended end use of the real property is important in basing a determination of the contaminated areas to be studied,

levels of cleanup required and applicable remedial action technology since end use will in large measure dictate the possible extent of exposure.

This assessment uses a modified form of "unrestricted use" for assessing decontamination of RMA lands and facilities. Although the ideal definition of unrestricted use would be complete decontamination to permit any Army, DOD, or public utilization of the affected real property, this may not be economically or technically feasible due to the presence of contaminated ground water and large volume of aquifer material. Thus, the term "unrestricted use" includes the concept of excluding use of contaminated ground water until such time in the future when the aquifer and surrounding aquifer materials are naturally cleansed. Several factors were instrumental in formulating this decontamination criterion:

- o Speculation of future non-Army land use at RMA is not appropriate since the Army does not determine land use for others.
- o Decontamination standards for less than unrestricted use are not available.
- o Contaminant site characterization is principally qualitative.

Although a number of unrestricted use scenarios could have been considered, only four options (Table 1) were deemed to be realistic until considerably more information is available. Partial cleanup scenarios consider only decontamination of select land areas with retention of certain facilities in a restricted



TABLE 1  
SUMMARY OF DECONTAMINATION SCENARIOS INVESTIGATED

PARTIAL RMA CLEANUP\*

- Option 1 - All contaminated materials in sections of land at RMA would be removed and placed in an on-site disposal facility located centrally to decontamination efforts. This option minimizes the potential of leachate contamination of the ground water.
- Option 2 - All contaminated materials would be removed except those in the four most contaminated sections of land (Sections 1, 2, 25 and 36). The waste removed from the other sections would be placed in an on-site disposal facility in one of the four restricted sections. Implementation of this option greatly reduces waste volume and costs from that considered in Option 1 but does not prevent the existing waste in these four sections from continuing to contaminate the ground water.

TOTAL RMA CLEANUP\*

- Option 3 - All contaminated materials at RMA would be removed and transported to existing out-of-state disposal facilities. This option permits decontamination of all RMA lands (except those associated with the operation of the boundary ground water systems).
- Option 4 - All contaminated materials at RMA would be removed and transported to an off-site Colorado disposal site. As in Option 3, boundary ground water control systems will be required until the aquifer cleanses itself.

\*Partial and total cleanup refer to the areal extent of decontamination, not to the degree of contamination cleanup. As noted elsewhere, a modified form of unrestricted use is considered for each of the options.

use mode. Total cleanup considers complete decontamination of all RMA lands and facilities.

Areas of contamination at RMA, as well as volumes and types of contaminated materials, are addressed in Chapter 3. Out of 165 possibly polluted sites on RMA, 88 were determined to possess a likelihood for contamination requiring decontamination to allow unrestricted use. The history of each site was carefully researched to generate supporting data on the areal extent and types of pollutants that may be present.

Volumes of contaminated materials were developed either through actual data or, for the majority of sites on RMA, through calculations using best engineering judgment. For example, soil removal volumes were calculated by multiplying each site's areal extent by an assumed depth based on historical activities conducted at the sites. Based on these calculations, it is estimated that about 16 million in-place cubic yards of contaminated buildings, equipment and soil are present at RMA. Since this data base is mostly qualitative, the calculations strike a balance between conservative values and what has actually been discovered so far at RMA.

Chapter 4 discusses technical approaches to decontaminate RMA lands and facilities for unrestricted use. All surface and subsurface contamination must be removed to the base of the contamination in order to achieve the unrestricted level of cleanup. Available technologies include removal, treatment and disposal. Based on technical feasibility, previous experience and economics,

the suggested decontamination technologies were: (1) excavation, (2) incineration where either required (chemical agent surety material) or economically justified as a volume reduction technique, and (3) landfilling.

Cost estimates for each cleanup option are developed in Chapter 5, which also contains a discussion of the cost estimating methodology. In order to develop costs for each option, it was necessary to discuss the methods to be used for excavation, transportation, treatment and disposal. It was concluded that front end loaders and hydraulic excavators were appropriate for excavation work. Truck transport was found to be the most cost effective for distances up to 800 miles (round trip) and rail transport most cost effective beyond that distance.

Off-site disposal costs were developed by considering a variety of disposal sites located within or adjacent to EPA Region VIII. The four most economical off-site landfills currently operating are in Idaho, Oklahoma, Texas and Missouri. A hypothetical landfill in Colorado located within a 150-mile round trip distance of RMA was also included. On-site disposal costs considered a centralized landfill on RMA. Landfill design criteria were also considered for cost estimating purposes.

Unit costs are developed in Chapter 5 for each decontamination activity: UXO clearance, building demolition, excavation, transportation, incineration, disposal, site reclamation and contaminant migration control. For the approximately 16 million in-place cubic yards of potentially contaminated materials present, the estimated total decontamination costs for the four cleanup options are as follows:

Option 1 - Partial RMA Cleanup Of All Sections           \$ 360 million  
Of Land Using A Central On-Site Landfill.

Option 2 - Partial RMA Cleanup Of All Sections           \$ 210 million  
Of Land Except 1, 2, 25 And 36 Using A  
Central On-Site Landfill.

Option 3 - Total RMA Cleanup Using Four Out-Of-       \$1,860 million  
State Landfills.

Option 4 - Total RMA Cleanup Using A Hypothetical       \$ 450 million  
Colorado Landfill.